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The PEA APHID ON PEAS

and methods for its control

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THE PEA APHID is present wherever peas are grown in the United States and is one of the most serious insect enemies of this important food crop. It has many generations a year, and under favorable conditions large and destructive populations of the pest may develop in a relatively short time. Natural enemies cannot be depended on for effective control, and therefore insecticides must be applied when threatening infestations of the aphid develop.

Several insecticides and methods for their use are discussed in this bulletin. The choice of these will depend on local conditions, including the type of machinery and insecticide available, but any of them will be effective if applied as directed.

In general, the most satisfactory treatment is the application of a dust mixture containing at least 0.5 percent of rotenone derived from ground roots of derris or cube mixed with pyrophyllite or talc. Directions are given for increasing the effectiveness of this mixture by adding either a conditioning agent or another insecticide such as nicotine or light lubricating oil. From 35 to 40 pounds of these dust mixtures are required per acre. Directions are given on pages 8 to 11 for their preparation and application.

The ground roots of derris or cube are also effective in the form of a liquid spray containing 3 pounds of this material and 4 to 8 ounces of a suitable wetting agent per 100 gallons of water, applied at the rate of 125 gallons per acre under a pressure of at least 300 pounds. (See pp. 11–13.)

The application of nicotine vapor by means of a special machine which utilizes an 80-percent free-nicotine preparation is very efficient if the treated plants are covered for 1 minute by use of a 100-foot gasproof apron dragged at a speed of 100 feet per minute. Three pounds of the nicotine preparation is required per acre.

Nicotine can also be used effectively under some conditions in the form of a dust mixture containing 4 percent of nicotine or a spray mixture containing 2 pounds of nicotine sulfate and 3 pounds of soap per 100 gallons of water.

Insecticides should be applied to keep down aphid populations. Heavy infestations are difficult to control, and during the process of building up they take a toll from the crop which means reductions in yield and quality.

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THE PEA APHID ON PEAS AND METHODS FOR ITS CONTROL

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THE PEA APHID (*Macrosiphum pisi* (Kalt.))[1] is one of the most destructive insect enemies of peas in this country. It has been recorded from every State of the Union and from several Provinces of Canada where peas or its other food plants are grown in any appreciable quantity. At one time or another it has been reported as a destructive pest in 25 States in this country scattered from Maine to California and from Washington to Florida, and in 13 of these States it is a pest of annually recurring importance.

APPEARANCE OF THE PEA APHID

The pea aphid is a small, light-green, soft-bodied insect nearly three-sixteenths of an inch long and one-third as wide. It obtains its food by sucking the sap from the plants on which it lives. Except for size, adults and young are similar in appearance (fig. 1). When food and weather conditions are favorable for the development of aphids most of them are wingless, although some individuals with wings can nearly always be found. Under unfavorable food conditions, however, many become winged and fly away in search of more favorable food plants.

CHARACTER OF INJURY

The pea aphid damages peas by sucking the sap from leaves, stems, blossoms, and pods (fig. 2). So rapidly may this aphid multiply under favorable weather conditions and when natural enemies are not abun-

[1] Order Homoptera, family Aphiidae.

dant that an infestation considered very light may increase to alarming proportions in less than a week. This makes it necessary to examine the peafield frequently so that if the aphids begin to increase, control measures may be applied in time to prevent serious injury to the crop.

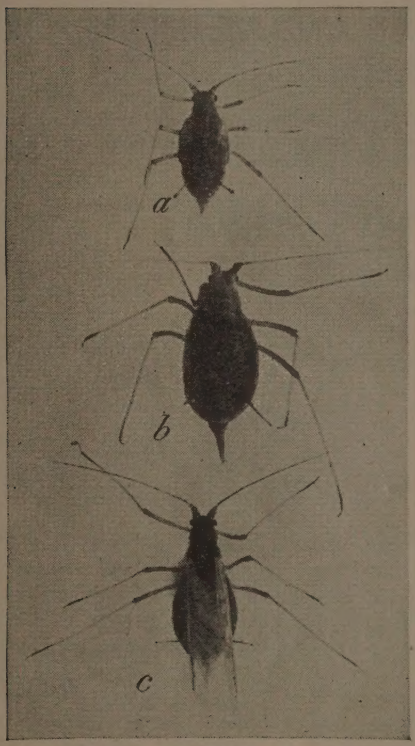

FIGURE 1.—Except for size, the adults and young of the pea aphid are similar in appearance. *a*, Young, or nymph; *b*, wingless adult female; *c*, winged adult female. Enlarged eight diameters.

Relatively few aphids may kill small pea plants under 6 inches in height, whereas an equal number might cause only slight injury to much larger plants. The damage may range all the way from a small reduction in the yield to complete loss of the crop. Minor damage may not be readily recognized in the field. The extent of the injury will be apparent, however, when the yield from slightly damaged plants is compared with the yield from plants upon which the aphid had been controlled satisfactorily.

If the injury is only moderate, the foliage may or may not turn brown, and the reduction in yield may result either from loss of vitality in the plant, causing it to produce fewer pods than usual, or from direct injury to the pods themselves, causing them to curl or shrink and to fill only partially with peas (fig. 3). Peas from such deformed pods do not shell out in the viner. In instances of extreme damage, entire fields may turn brown, and the plants may die before any blossoms are produced.

FOOD PLANTS

Peas are the most widely distributed and the most favored food plants of the pea aphid. These include all edible peas, whether grown for the table, for seed, or as a cover crop, and sweet peas grown for their flowers. Every State in the Union grows peas for one or another of these purposes. The commercial planting of edible peas in 1942 was approximately 984,000 acres.

Alfalfa ranks next to peas as a favored food of the pea aphid. In the North, however, these aphids seldom reproduce abundantly on alfalfa, and they begin to desert it as soon as the first crop starts blossoming, in spite of the fact that alfalfa enabled them to live

FIGURE 2.—The pea aphid is especially destructive when it infests pea pods.

FIGURE 3.—Abnormal and deformed pods (upper row) injured by the pea aphid produce very few peas, and these do not shell out in the viner as do peas from normal, uninjured pods (lower row).

through the winter and begin their reproduction in the spring. An average of 14,000,000 acres of alfalfa is grown in the United States annually.

Although several kinds of clover, including red, alsike, and crimson, as well as the sweetclovers, are fed upon by the pea aphid, they are

seldom damaged to any serious degree. In some parts of the country the pea aphid occasionally damages several kinds of vetch. Other plants, in addition to those mentioned, have been recorded as hosts of the pea aphid, but they are of minor importance when compared with these legumes.

LIFE HISTORY AND HABITS

In the northern part of the United States the pea aphid spends the winter in the egg stage, the tiny, shining-black eggs being glued

FIGURE 4.—Masses of white molted skins of the pea aphid on the ground show that a heavy infestation has been, or still is, present on the plants.

to the stems and fallen leaves of alfalfa and of some of the clovers. In the southern part, on the other hand, this aphid remains active during a good deal of the winter, feeding and reproducing on peas and such other legume as may be available. There is a belt through the central part of the country, probably extending up into the Pacific Northwest, where the method of overwintering is not uniform. In this belt, eggs may be laid or the aphids may pass the winter in a more or less inactive state, or both eggs and aphids may be present. To some degree the weather of the fall and the early part of the winter probably governs the method of overwintering in this belt.

In the North, from late in March to early in May, depending on the latitude and local weather conditions, the overwintered eggs hatch into wingless young, or nymphs. When mature, these are called stem mothers and are darker green than the aphids of subsequent generations. These stem mothers give birth to young aphids, which when mature produce another generation in like manner, and so on, until a large number of generations have appeared. In southern Wisconsin as many as 17 generations have been recorded in 1 year, although 14 or 15 generations is nearer the average. All the countless numbers of summer individuals are females and produce living young without mating.

During growth from young nymph to adult, the pea aphid sheds its frail skin four times. In heavy infestations many thousands of these molted skins collect in whitish piles on the ground beneath the plants (fig. 4). These are sometimes mistaken for dead aphids. These cast skins show that a heavy infestation has been, or still is, present.

Sometime in October, in the latitude of Madison, Wis., a change in the forms appears, and aphids are born which, when mature, can be separated into several classes. Some are still female-producing mothers; but some are egg-producing mothers, and others are males, some of which are winged and some wingless. After mating has taken place, fertilized eggs are laid on alfalfa and, to a lesser extent, on some of the clovers.

Until recently it was believed impossible for such a frail insect as a winged pea aphid to migrate any great distance, even when carried along by a light wind. Evidence has been accumulated, however, which points to the probability that certain heavy infestations of winged aphids appearing suddenly in peafields, both in Illinois and in Wisconsin, have been borne by southerly winds for distances of from 25 to 100 miles or perhaps even farther.

NATURAL ENEMIES

The pea aphid's natural foes may be divided into three classes—insect enemies, fungous and bacterial enemies, and miscellaneous enemies.

INSECT ENEMIES

Over 70 species of predatory and parasitic insects regularly or occasionally attack the pea aphid. These may be divided into the following five main groups: (1) Some 16 species of ladybird beetles; (2) some 25 species of hover flies; (3) 2 or 3 species of true parasites; (4) 3 or 4 species of lacewing flies; and (5) a large number of miscellaneous insects, some of which occasionally may be of value in controlling the aphid. These groups vary in abundance and importance from year to year.

FUNGOUS AND BACTERIAL ENEMIES

One principal species of fungus and one or more species of bacteria attack the pea aphid, causing its death. Aphids killed by disease are in evidence every year in the fields, but unless weather conditions are favorable for their rapid propagation these diseases do not usually

become an important factor in the control of the aphid. Occasionally one of these diseases may sweep through the peafields as an epidemic and in a short time kill a great majority of the aphids, but very likely not before the aphids have already damaged the plants.

MISCELLANEOUS ENEMIES

Several other enemies, such as spiders, mites, and birds, may destroy large numbers of pea aphids, especially when the aphids are unusually abundant.

THE ROLE OF NATURAL ENEMIES IN PEA APHID CONTROL

When one or more groups of these natural enemies are present there is no question but that they reduce greatly the abundance of the aphids and reduce the amount of damage that otherwise would have occurred. It must be recognized, however, that the infestation of the aphid must be heavy before large numbers of its enemies can reproduce and survive. In general it appears that unless conditions are very favorable for the natural enemies they cannot effect control, and therefore cannot be depended on, and insecticidal control is necessary when threatening infestations of the aphid develop.

CONTROL MEASURES

Because the pea aphid can multiply very rapidly and because under some conditions relatively few aphids per plant may cause serious injury, these pests must be fought with a control measure that will kill 90 percent or more of them with one application. In any event, such a control measure must be so effective that it not only will stop damage by the aphid but will also reduce its abundance to such an extent that it cannot again increase to injurious numbers before harvest.

The pea aphid may be controlled profitably by the efficient application of insecticides containing either nicotine or the rotenone-containing roots of such plants as derris and cube. Although the application of rotenone-containing roots in the form of dust mixtures has generally proved to be the most satisfactory method of controlling the pea aphid, the best method for use by any one operator will depend upon a number of factors, including the type of machinery on hand and the insecticides available.

Although rotenone kills more slowly than nicotine, it continues to kill the aphids for several days after its application, and it may be used more successfully at low temperatures than nicotine. Nicotine applied in the form of dust mixtures or sprays kills the pea aphids that are reached by it more quickly than does rotenone, but the insect-killing effect of nicotine is rapidly dissipated, and at temperatures below approximately 65° F. the performance of this insecticide is uncertain. Vaporized nicotine is very effective but it requires special equipment and trained operators for best results and is therefore not so widely adaptable as are the dust and spray mixtures.

Insecticide applications against the pea aphid should be begun before the plants have suffered appreciable damage. Much of the effectiveness of any of the insecticides mentioned in this bulletin de-

pends on the proper preparation and prompt and thorough application of the one chosen. The details of these precautionary requirements will be discussed in following sections of this bulletin.

The machinery used in applying insecticides damages the pea vines that are in the path of the wheels. The degree of damage, however, is small as compared with that which might be caused by aphids if insecticides were not applied. Actual measurements indicate that the damage caused by a truck with 6-inch treads, carrying a dusting machine that dusted a 24-foot swath of peas, ranged from 1.8 to 3.6 percent, in weight, of marketable pods during the 3-year period 1939–41.

NOTE.—In view of the shortage of rotenone which has been imposed by war conditions, with the consequent necessity of conserving available supplies of this material, it is suggested that if rotenone cannot be obtained, or whenever conditions permit, an attempt be made to substitute nicotine dust mixtures and sprays for those containing rotenone.

DUST MIXTURES CONTAINING DERRIS OR CUBE

It is recommended that derris or cube dust mixtures for the pea aphid contain at least 0.5 percent of rotenone derived from ground rotenone-containing roots diluted with pyrophyllite or talc. They should be applied at the rate of 35 to 40 pounds per acre under a cloth apron at least 25 feet long drawn along over the plants behind the duster.

Derris and cube are leguminous plants, members of the pea family, the roots of which are imported from southern Asia and from South America. These roots contain rotenone and other ingredients that are effective in killing certain insects, including the pea aphid. Although other toxic materials are present in the roots, rotenone is the "yardstick" with which the value of the roots and mixtures containing them is measured. For convenience, therefore, mixtures containing these materials will be referred to in this bulletin as rotenone mixtures. It has been demonstrated that although the degree of control varies according to the quantity of actual rotenone applied per acre, 0.2 pound of rotenone per acre is sufficient. This is equivalent to 40 pounds of a dust mixture containing 0.5 percent of rotenone.

DUST MIXTURES CONTAINING ROTENONE PLUS OTHER INSECTICIDES

Rotenone dust mixtures are more effective if some conditioning agent such as the proprietary spreading-and-wetting agents or a light lubricating or mineral oil is added in sufficient quantities to constitute 1 percent of the dust mixture. Likewise the efficiency of rotenone mixtures may be increased by the inclusion of nicotine alkaloid or of a commercial organic thiocyanate mixture at the rate of 2 percent by weight. In preparing rotenone-nicotine mixtures, the rotenone dust should be mixed with sulfur before nicotine is added, and the sulfur should constitute about 10 percent of the finished product.

Caution.—Some observations indicate that materials such as nicotine, the thiocyanates, and oils, which cause increased toxicity of rotenone mixtures, may also have a deteriorating effect on such mixtures in prolonged storage. It is not advisable, therefore, to buy or prepare a greater quantity of these mixtures than is likely to be needed in the current season, regardless of the available supply.

PREPARING AND APPLYING ROTENONE DUST MIXTURES

Ready-prepared dust mixtures can be purchased or the different ingredients may be obtained separately and mixed in sifting and mixing machines manufactured for this purpose. Rotenone dust mixtures are sold under various trade names, but the content of active insecticidal materials and directions for application should be found on the package. These directions should be followed.

To prepare homemade mixtures use the ground roots of derris, cube, or similar plants.[2] These materials are usually standardized to contain 4 or 5 percent of rotenone and should be of such a degree of fineness that all of it will pass through a sieve having 80 meshes to the linear inch and not less than 90 percent of it through a sieve having 200 meshes per inch.

To prepare a dust mixture containing 0.5 percent of rotenone and 1 percent of oil, use the following formula:

Derris or cube powder (4 percent rotenone content)	6¼ pounds.
Talc or pyrophyllite (do not use lime)	43¼ pounds.
SAE 10 lubricating oil	½ pound (½ pint).

If the percentage of rotenone in the ground derris or cube is substantially different from 4 percent, the number of pounds of ground root to be used in preparing the dust mixture can be calculated as follows:

Divide the percentage required in the finished dust mixture by the percentage in the stock material and multiply by the number of pounds of finished dust required. For example, to prepare 50 pounds of dust mixture containing 0.5 percent of rotenone from ground derris root containing 5 percent of rotenone, divide 0.5 by 5 and multiply the product by 50, which gives 5. Therefore use 5 pounds of ground derris containing 5 percent of rotenone and ½ pound of oil. This is a total of 5½ pounds, so the remaining 44½ pounds of the 50 pounds of mixed dust is composed of the diluent. If, in using 5-percent derris dust, nicotine alkaloid and sulfur are to be used instead of the oil, use 1 pound of the nicotine alkaloid and 5 pounds of sulfur, which, together with 5 pounds of derris, will require only 39 pounds of talc or pyrophyllite to make the 50 pounds of mixture.

An ordinary sifting and mixing machine of the type employed for blending flour can be used for mixing the materials. A satisfactory mixer can be made also from a cement mixer (fig. 5) by providing a removable top that will retain the dust during the mixing process. A 10-quart pail of round stones about the size of hen's eggs should be placed with the dry materials in a mixer of this type. The mixer is put in motion and after about 5 minutes, while the drum is turning, the spreading agent or any liquid material to be added is sprayed into the dust through a hole in the top of the mixer by means of a pressure sprayer of the type used for spraying paints. The materials should be mixed for at least 30 minutes, after which the mixture should be sifted to remove the stones.

The dust mixture should be applied at the rate of 35 to 40 pounds per acre in such a manner as to apply a coating of the insecticide on

[2] Because of war conditions cube is probably the only type of root that can be obtained at this time.

FIGURE 5.—A modified concrete mixer makes a satisfactory machine for preparing derris or cube dust mixtures. The spreading agent is being sprayed into the drum.

all parts of every plant. This can best be done with a modern power duster (fig. 6). An apron or trailer of unbleached muslin or canvas should be so attached to the duster as to enclose completely the boom and the pea plants being treated for at least 25 feet behind the boom.

In the presence of light breezes the use of the enclosed boom with the apron or trailer makes it possible to delay the wind drift of the dust long enough for the insecticide to settle among and on the pea foliage much better than if this device were not employed. For the best possible distribution of the insecticide to all parts of the plants the boom should be adjusted so that it is just above the tops of the plants. The speed of the dusting machine should not exceed 3 to 4 miles per hour, or about 300 to 400 feet per minute. Even with the use of the apron the dust applications cannot give the best results if the wind velocity is more than approximately 8 to 10 miles per hour.

FIGURE 6.—For best results a modern power duster with the boom entirely enclosed and a 25-foot trailer of unbleached muslin attached should be used to apply the dust. This picture shows twin power dusters mounted on a single truck.

For best results the duster should be equipped with a boom that is adjustable to various heights of pea vines, and the duster should have sufficient power to drive the dust among the plants so as to cover all parts above ground, and it should give an even distribution of the dust throughout the entire length of the boom. The moving parts of the duster should be kept well lubricated. The duster should be cleaned out thoroughly at the beginning of the season and several times during the period of operation by removing all accumulations of caked dust from the dust hopper, fan case, tubes, and nozzles. The efficiency of the duster will be increased by such care.

In certain instances under observation the application of derris or cube dust mixtures has failed to control the pea aphid to a satisfactory degree. While some of these failures cannot be explained on the basis of our present knowledge, some of them can be charged to one or more of the following causes: (1) Improper mix-

ing of the insecticide; (2) too low a rotenone content in the dust mixture; (3) improper application of the insecticide, such as adjusting the boom or booms below the level of the tops of the vines or operating with one or more of the nozzles clogged; and (4) inefficiency of the duster, revealed by too much variation in the quantity of the dust mixture discharged from different outlets of the boom, variations in output due to lack of adjustment to different types of dust mixtures used, and variations in the quantity of the dust mixture delivered to the fan through the feed mechanism.

In most instances, however, derris or cube dust mixtures, when properly prepared and applied according to the methods given in preceding paragraphs of this bulletin, have protected pea plants from appreciable aphid damage, and their use over a period of years may be expected to result in a substantial increase in the yield of peas.

SPRAYS CONTAINING DERRIS OR CUBE

Sprays containing rotenone prepared from derris or cube have in general given good results in pea aphid control. The use of sprays, however, is subject to some handicaps, since the spray machinery is usually heavier than dusting machinery and frequently causes more mechanical injury to the crop than the dusters, particularly in wet soils having a high clay content. The obtaining of water for use in sprays when large areas are being treated may also add an extra expense, and it makes spraying a time-consuming operation as compared with dusting.

If it is desired to use rotenone sprays rather than dust mixtures for pea aphid control, the following methods should be adopted: On the basis of ground derris or cube root containing 4 percent of rotenone, 3 pounds should be sufficient per 100 gallons of water. Corresponding dilutions should be used with derris or cube containing more or less than 4 percent of rotenone. For example, if the ground root contains 3 percent of rotenone, 4 pounds should be used, and if the ground root contains 5 percent of rotenone, 2½ pounds should be used. In any event the spray should contain approximately 0.015 percent of rotenone. Undiluted ground derris or cube makes a better spray suspension than do any of the finished dust mixtures prepared for dusting purposes.

Several proprietary spreading-and-wetting agents, both in liquid and in powdered form, sold under various trade names, are suitable for use in increasing the effectiveness of derris or cube sprays. The proper quantity of the spreading-and-wetting agent to be used in the spray varies with the different brands of these materials, and the dilution recommended by the manufacturer of each brand should be used. Ordinarily the liquid form is used at the rate of approximately 1 pint and the dry form at the rate of approximately ½ pound per 100 gallons of spray. To mix it thoroughly with large quantities of water, the ground derris or cube should first be made into a smooth paste by adding a small quantity of water or of a mixture of water and the spreading-and-wetting agent. The paste should then be added to the remaining water in the spray tank with constant agitation so that the paste is mixed thoroughly with the water.

The spray should be applied at the rate of from 125 to 200 gallons per acre, preferably with a modern power sprayer (fig. 7), in such a manner as to cover all parts of the plants thoroughly. The nozzles should be kept about 6 inches above the tops of the plants. Pump pressure should be at least 300 pounds. The speed of the sprayer should not exceed 3 to 4 miles per hour, or approximately 300 to 400 feet per minute. It is important that the spray machine be kept clean and that the spray nozzles be examined frequently during the spraying operations to make certain that each is delivering the spray material.

VAPORIZED NICOTINE

The method of control of the pea aphid by use of vaporized nicotine is one of the most recent developments. This method, developed by a commercial company, consists essentially of injecting a concentrated nicotine preparation (containing 80 percent of free nicotine) into the

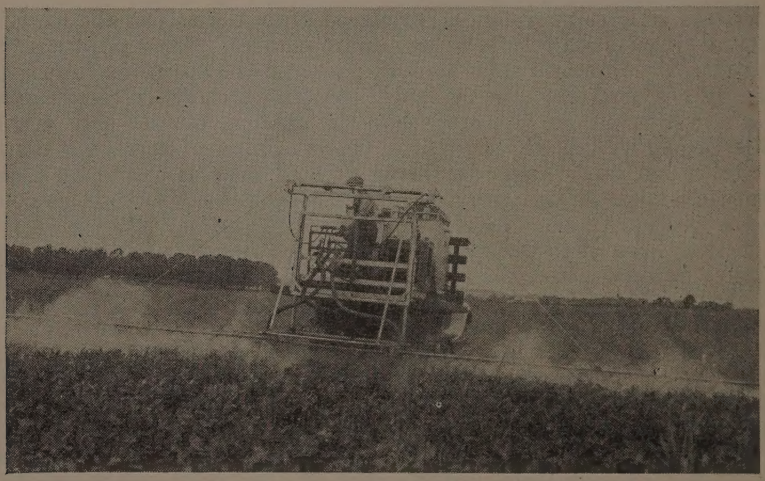

FIGURE 7.—A modern power sprayer with a long boom and closely spaced nozzles assures thorough coverage of the pea plants.

exhaust pipe of a gasoline engine while the engine is running at comparatively high speed. The vaporized nicotine produced in this manner is blown out through a boom at the rear of a machine especially built for this purpose. The vapor is expelled under a gasproof cloth attached to the boom and allowed to drag over the peas (fig. 8). This cloth trailer should be 100 feet or more in length and should be moved over the field not faster than 100 feet per minute. The peas will thus be exposed to the vapor for approximately 1 minute, and 98 percent or more of the aphids present should be killed. Three pounds of 80-percent free nicotine should be applied per acre.

NICOTINE DUST MIXTURES AND SPRAYS

Under conditions favorable for treatment, the application of nicotine dust mixtures containing approximately 4 percent of nicotine will give fairly satisfactory control of the pea aphid. For a nicotine dust

FIGURE 8.—Fumigation of growing peas for the pea aphid with vaporized nicotine under a long trailer kills a large proportion of the insects.

mixture to be effective it must be applied on dry foilage, when the air is calm, and during a time when the temperatures are above approximately 65° F. At temperatures below this point the nicotine does not volatilize properly.

A dust mixture containing 4 percent of nicotine can be prepared as follows:

	For mixing 100 pounds of dust (pounds)	*For mixing a smaller quantity*[1] *(pounds)*
Nicotine sulfate[2] containing 40 percent of nicotine	10	6¼
Monohydrated copper sulfate	10	6¼
Hydrated lime	80	50

[1] A convenient quantity to prepare in a self-mixing duster.
[2] A solution containing 40 percent of nicotine by weight.

The nicotine dust mixture should be applied in a manner similar to that described for the derris or cube dust mixture, and at a rate ranging from 40 to 50 pounds per acre, depending on the size of the pea plants and the density of their growth. A light trailer, at least 40 feet in length, drawn behind the duster confines the nicotine fumes among the pea plants for a longer period than would otherwise be the case, and increased efficiency from the nicotine is obtained. In addition to the use of the trailer, the boom should be enclosed with muslin or canvas in the same manner as described for applying dust mixtures containing derris or cube. The speed of the duster should not exceed approximately 1 mile per hour, or 100 feet per minute.

For preparing nicotine spray mixtures for use in controlling the pea aphid the following formula can be used:

Nicotine sulfate (containing 40 percent of nicotine)	1 gallon
Soap	15 pounds
Water	500 gallons

The rate and method of application are the same as recommended for derris or cube sprays. Nicotine sprays should not be applied when the temperature is below 65° F.

NICOTINE-OIL OR ROTENONE-OIL COMBINATIONS

In addition to the insecticides mentioned in the preceding paragraphs there are several other materials that may be used to combat the pea aphid.

Several brands of commercially prepared insecticides consisting essentially of a concentrated nicotine-oil or rotenone-oil combination have been developed especially for application in a finely divided or atomized form against the pea aphid and other insects. These are sold under various trade names and should be used according to the directions of the manufacturer.

PROPER TIME TO APPLY INSECTICIDES AGAINST THE PEA APHID

Insecticides should be applied before the aphids become sufficiently abundant to damage the peas. The plants should be examined frequently for the presence of aphids and a record made of the degree of the aphid infestation. A convenient method of measuring the infestation is by making single sweeps in five representative parts of the field with an ordinary insect-collecting net and counting the aphids captured. This should be done when the plants are relatively dry. Any insect-collecting net having a diameter of 11 to 14 inches and a handle 2 to 3 feet long may be used for this purpose. Each stroke should be made quickly enough to knock off into the net a large proportion of the aphids present, without damaging the pea vines.

An infestation that yields 30 to 40 aphids per sweep of the insect net, or of 1 aphid per plant on plants too small to be swept, constitutes a menace that either should be treated immediately or should be carefully watched for further developments. The time which the grower can afford to delay the application after this infestation develops will depend upon the rate at which the infestation increases as well as on the acreage to be cared for and available facilities. This degree of infestation is capable under favorable conditions of increasing sufficiently during a period of 3 or 4 days to cause serious damage to the crop. Treated fields should be examined frequently, and if one application of insecticides is not effective in keeping the aphids in check, a second one should be made.

Insecticides are most effective and their use most profitable when conditions are favorable for the growth of the plants. They are not so effective when the plants are stunted because of drought or other unfavorable growing conditions as when the plants are thrifty. Some varieties of peas develop clamshell-like buds about the time the plants begin to bloom. The aphids feed within these buds, where they are difficult to reach with insecticides. Sometimes it is advantageous to apply insecticides just before the plants reach this stage of growth.

WHERE INSECTICIDES MAY BE PURCHASED

Information regarding the purchase of the insecticide materials mentioned in this bulletin may be obtained through local dealers in agricultural supplies, seedsmen, general stores, and department stores, or through county agricultural agents, State agricultural experiment stations, State agricultural colleges, or State departments of agriculture.

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